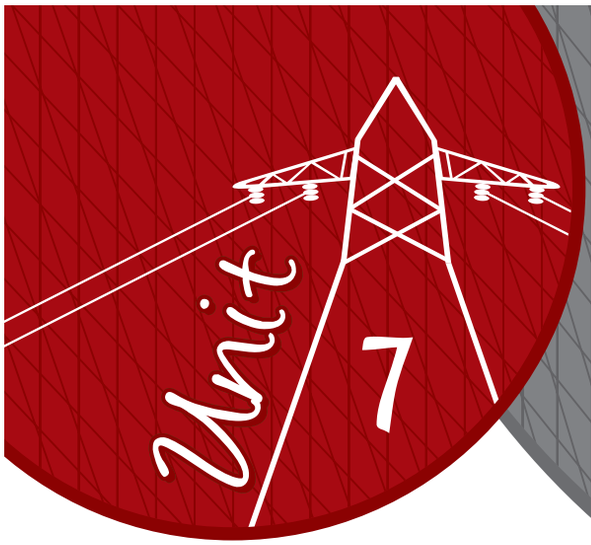

Tools and Equipment

Introduction

An ammeter measures current, a voltmeter measures the potential difference (voltage) between two points and an ohmmeter measures resistance. A multimeter combines these functions and possibly some additional ones as well into a single equipment. Various tools and equipment, such as screwdriver, phase tester, stripper and pliers are used to carry out electrical panel installation. In this Unit, students will learn about these tools and equipment.

Multimeter

Multimeters are test instruments. By operating a multi-position switch on a multimeter, it can be easily be set to function as a voltmeter, an ammeter or ohmmeter. A multimeter has several settings (called ranges) for each type of meter and the choice of AC or DC. Some multimeters have additional features, such as transistor testing, and ranges for measuring capacitance and frequency. Multimeters are available in digital and analog types.

Fig. 7.1 Digital multimeter

Fig. 7.2 Twisting the selector knob

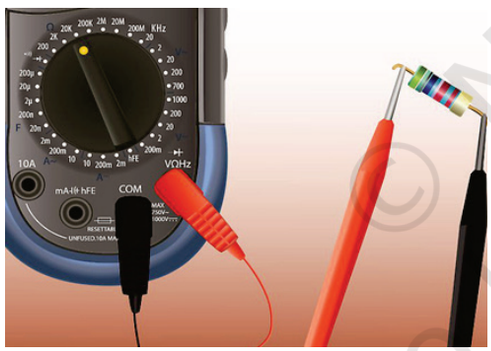

Fig. 7.3 Touching the tips of the probes

Fig. 7.4 Multimeter reading

Measuring resistance using digital multimeter

A digital multimeter has two probes. Resistance can be measured using these probes.

- Insert the black probe into the common terminal and the red probe into the terminal marked for measuring Volt and Ohm. The terminal may also be marked for testing diodes.
- Twist the selector knob to set the multimeter to measure resistance. This may be represented by the Greek letter Omega (Ω), which stands for Ohm, the unit of measurement for resistance.
- Touch the tips of the probes to each side of the resistor.
- Read the display and carefully take note of the units. A reading of 10 may indicate 10 Ohm, 10 kilo-Ohm or 10 mega-Ohm.

Measuring AC and DC voltage using digital multimeter

- Resistance can be measured using the two digital multimeter probes. Put the black probe in the common terminal and the red probe in the terminal marked for measuring Volt and Ohm.
- Set the multimeter for voltage to be measured. You can measure volts DC (direct current), millivolts DC or volts AC (alternating current). If the multimeter has an auto-range function, it is not necessary to select the voltage you are measuring.
- Measure AC voltage by placing the probes across the component. In case of AC, it is not necessary to observe the polarity.
- Observe the polarity when measuring DC voltage or millivoltage. Place the black probe on the negative side of the DC

source and the red probe on the positive side of the DC source.

- Read the display, carefully to note the units. You can also use the touch-hold feature to keep the reading on display after removing the probes. The multimeter will beep each time a new voltage is detected.

Fig. 7.5 Digital multimeter probes

Measuring AC and DC current using multimeter

- Choose either the terminal marked for measuring 10 amps or the one marked for measuring 300 milliamps (mA). If not sure of the current, start in the 10 amp terminal until confident that the current is less than 300 milliamps.
- Set the multimeter to measure current. This may be represented by the letter 'A'.
- Turn off power to the circuit.
- Break the circuit. To measure current, you must place the multimeter in series with the circuit. Place the probes on either side of the break, observing polarity, such as black probe on the negative side and red on the positive.
- Turn the power on. The current will run through the circuit up the red probe and through the multimeter, then out of the black probe and into the circuit.

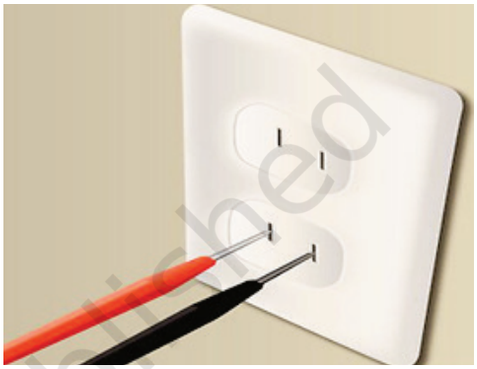

Fig. 7.6 AC voltage measurement

Fig. 7.7 DC Voltage measurement

Fig. 7.8 AC voltage value

Fig. 7.9 Probes of multimeter connected to current measurement slot

Fig. 7.10 Switch on the selector knob to measure current

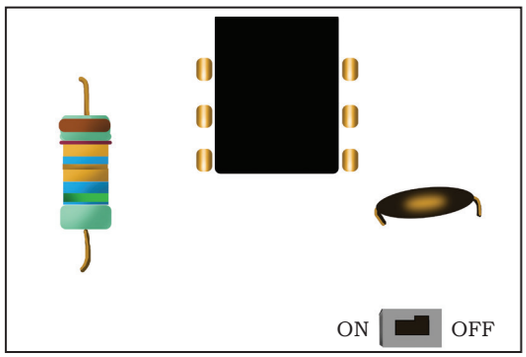

Fig. 7.11 Turn off the current using switch

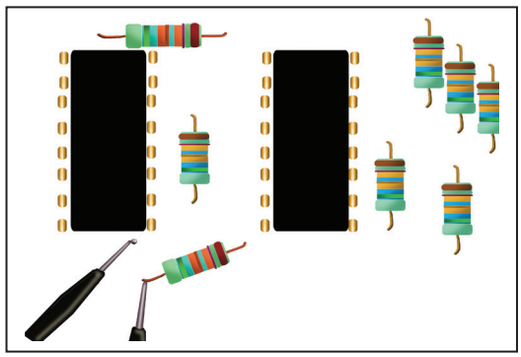

Fig. 7.12 Place the multimeter probe terminals to current measuring point

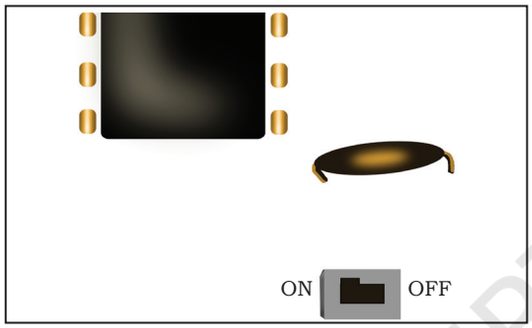

Fig. 7.13 Turn on the circuit using switch

Fig. 7.14 Current value on multimeter display

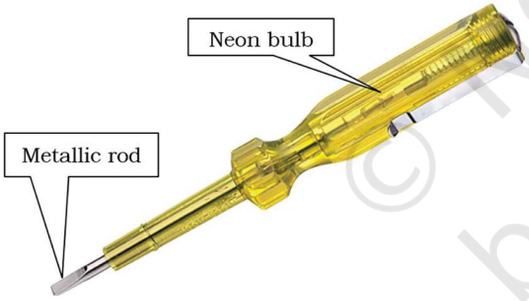

Fig. 7.15 Phase tester

- Read the display. Remember whether you are measuring amps or milliamps. You can use the touch-hold feature, if required.

Line or phase tester

Phase or line tester is used to identify or test the phase of a socket. Line tester is also called 'neon screwdriver' or 'test pin'.

Construction of phase or line tester

The following are the main parts of a typical phase or line tester.

Metallic rod and mouth

It is a cylindrical metal rod. The flat end (mouth) is used as a screwdriver or touch electrical conductor or wire to find phase or live wires, and the other end is connected to resistance, neon bulb, element and metallic cap screw.

Body and insulation

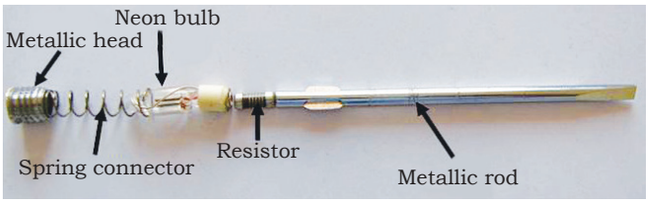

Fig. 7.16 Parts of a phase tester

Components, such as resistance, neon bulb, element or metallic spring and metallic cap screw are covered in a transparent insulated body made of plastic. The flat end of the cylindrical metal rod is also covered with transparent insulated plastic for insulation purpose, except the mouth.

Resistor

It is an element, which opposes the flow of current through a phase tester. In the phase or line tester, the resistor is connected between the cylindrical metal rod and neon bulb. This resistor controls the current passing through the neon bulb. Without a resistor, high current may damage the neon bulb. Moreover, it would not be safe to use the phase tester without a resistor.

Neon bulb

Neon bulb is connected between the resistor and metallic spring. It is used as a phase indicator bulb. When a small current flows through it, it glows. Due to the presence of the neon bulb, a phase or line tester is also called a neon screwdriver.

Element (metallic spring)

It is used to make connection between the neon bulb and metallic cap screw.

Metallic cap screw and clip

The screw is used for tightening all components in the phase tester. The screw is connected to the spring (element) and the spring (element) to the neon bulb. The metallic clip is used for holding the phase tester in pocket.

Screwdriver

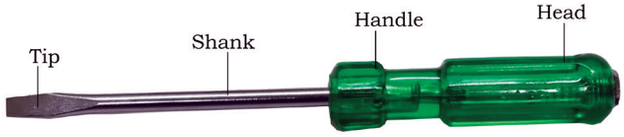

Fig. 7.17 Screwdriver

A screwdriver is the basic tool used in electrical panel installation. It is manual or powered, and is used for inserting and removing screws. A screwdriver has a handle and a shaft. A user puts the end tip of the screwdriver into the screw before turning

the handle. The shaft is, usually, made of tough steel. It is used to resist bending or twisting. The tip may be hardened to resist wear. Handles are made of wood, metal or plastic. The handle is, usually, hexagonal, square or oval in cross section to improve the grip. This is helpful when twisting the screwdriver and also helps prevent the tool from rolling on the head of the screw. Some manual screwdrivers have interchangeable tips that fit into a socket at the end of the shaft and are held mechanically or magnetically. These often have a hollow handle that contain different types and sizes of tips.

Fig. 7.18 Clamp meter

Clamp meter

It is a tool for measuring current in a wire. As compared to the multimeter, a clamp meter does not need to be connected to a circuit in order to read the current. It does not require breaking the circuit to measure current. The clamp on the device is placed around a live wire. This allows one to measure the current in the wire without interrupting the operation of the electrical appliance. The clamp meter uses digital technology to bring instantaneous readings.

Steps for measuring AC or DC current using clamp meter jaws

Choose an electrical conductor

The clamp meter can measure the current on a load without disconnecting the electrical conductor from the circuit. To get a reading, the electrical wire needs to be connected to an operational electrical appliance.

Choose appropriate function and range

Set the rotary switch on the clamp meter to appropriate function and range. Measuring current that is higher than that specified in the range can damage the device. If not sure about the range of the current to be measured, choose a high range clamp meter.

Clamp the conductor

Push the trigger on the device to open the jaw. Clamp the device around the conductor and close it. If the electrical conductor is not yet connected to a power source, connect it. Note the reading on the display of the clamp meter.

Use an AC line separator

When measuring AC current, the device may give false reading. Current in hot and neutral wire cancel each other, which causes the device to display nothing on the LCD screen. To correct the problem, connect the AC line separator between the electrical conductors, i.e., phase and neutral.

Measure voltage

Set the clamp meter to the voltage symbol 'V' to read the voltage on the conductor. Plug the probes to the meter as well. Connect the black probe to the common jack and the red to the voltage omega jack. Select the appropriate range of voltage. Remember that voltages above the maximum range on the clamp meter are not measured. Touch the tips of the probes with the electric conductor to get a voltage reading. Read the voltage on the LCD screen. The clamp meter will help save time during an electrical repair work, increase efficiency in carrying out wiring projects and protect a person or wireman from accidents.

Plier and wire stripper

A combination plier, as the name suggests, performs various operations. It enables to perform a combination of operations, i.e., cutting and gripping. Some combination pliers have other additions, especially, if they are designed for use in particular industries or for specific tasks.

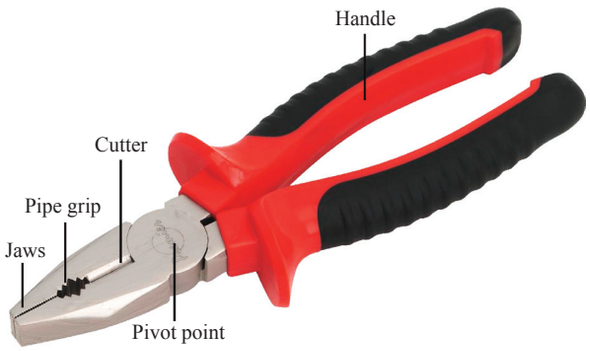

Fig. 7.19 Combination plier

Handles

The handles of combination pliers, usually, have a plastic coating, for comfort and grip. The size and length of the handles depend on the size of the pliers. Pliers

Fig. 7.20 Chuck key

Fig. 7.21 Turn the chuck key counter clockwise

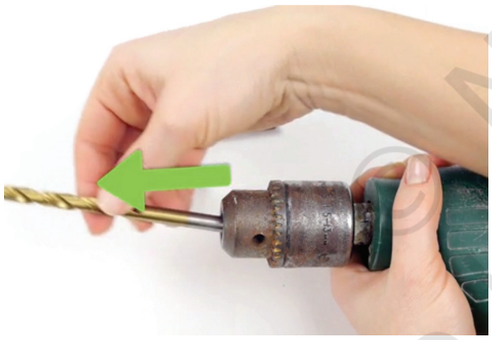

Fig. 7.22 Slide the drill bit out

Fig. 7.23 Insert new drill bit

designed for use by electricians and linemen have insulated handles.

Jaws

The jaws of the combination plier opens and closes along with the handles. They have flat edges for general gripping, which are often serrated for extra grip. Sometimes, they are smooth but they, usually, have squared tips.

Cutter

The cutters built into the jaws of the combination plier are, usually, designed to cut cables and wires.

Pipe grip

The pipe grip is a rounded cutout in the jaws of the plier. It is, primarily, used for gripping rounded stock like pipes and cables.

Pivot point

It is a kind of hinge that allows the handles and tips to open and close so that the jaws can grip or cut, and then, be opened again.

Drill bits

Drill bits are cutting tools used to make holes. These are used in circular motion. They come in many sizes and shapes. Different size of holes can be made by using different size of bits. In order to make holes, drill bits are, usually, attached to a drill machine, which powers them to cut through a work piece, typically, by rotation.

One must insert the chuck key. If a drill is with a chuck key, one needs to use it in order to loosen the chuck. To insert the chuck key, one must line up the teeth so that they match the teeth on the chuck and insert the tip into one of the holes on the side of the chuck. Then, the person must turn the chuck key counter clockwise (Fig. 7.21). As the key is turned, the jaws on the chuck will begin to open. One must

continue turning until the chuck opens enough to easily slide the drill bit out. The jaws are the three or four pieces in the mouth of the chuck that extend to hold the bit in place.

Now, the person needs to remove the bit. Once the chuck is loosened, the person must pull the bit out using the thumb and index finger. If the chuck is opened wide and the drill is turned downwards, it may fall out.

Now, inspect the bit for damage. If the bit is dull, it must be replaced. If it is bent or shows signs of cracking, it must be thrown away.

One must insert a new bit. While the jaw on the chuck is wide open, the new bit must be inserted. Hold the bit with the thumb and index finger so that the smooth part of the bit (shank) faces the jaws of the chuck and insert it.

Keep the fingers on the bit and the chuck as the bit is not secure and may fall.

Soldering

Soldering is the process of melting a metal onto other metal components in order to bind them. Soldering differs from welding. In welding, the component pieces are melted together, whereas, in soldering, a softer metal with a lower melting point is used to connect them. Since soldering does not melt components, it is useful for delicate applications, such as electronics work or plumbing. The purpose of soldering is to bind two components together. Solder can be thought of as a sort of 'metal glue'. It can be used to fill in the gaps or hold the pieces in place but does not serve any other complicated purpose. Since solder is metallic, it conducts electricity. That is why, it is commonly used for connecting electronic components.

Fig. 7.24 Soldering kit

Megger meter

Insulation resistance (IR) quality of an electrical system degrades with time and environment conditions, i.e.,

temperature, humidity, moisture and dust particles. It also gets impacted negatively due to the presence of electrical and mechanical stress. So, it becomes necessary to check the IR of the equipment at regular intervals to avoid incidences of electrical shock. A megger meter is used as a measuring equipment for insulation resistance tester.

Use of megger meter

This device is used to measure electrical leakage in a wire. The results are reliable as electric current passes through the device while testing goes on. The equipment is used for verifying the electrical insulation level of devices, such as motors, cables, generators, windings, etc. This test need not show us the exact area of electrical puncture but shows the amount of current leakage and moisture level within the electrical equipment or winding or system.

Fig. 7.25 Electronic megger meter

Types of megger meter

There are mainly two types of megger meter.

- Electronic megger meter (battery operated)
- Manual megger meter (hand operated)

But there is another of megger meter, which is motor operated and does not use battery to produce voltage. It requires an external source to rotate an electrical motor, which in turn, rotates the generator of the megger.

Electronic megger meter

The important parts of an electronic megger meter are as follows.

Digital display

It shows the IR value in digital form.

Wire lead

It connects the megger with the electrical external system to be tested.

Selection switch

It is used to select electrical parameters ranges.

Indicators

It is used to indicate various parameters status, i.e., ON or OFF. For example, power, hold, warning, etc.

Manual megger meter

The important parts of a manual megger meter are as follows.

Analog display

It is provided on the face of the tester for IR value recording.

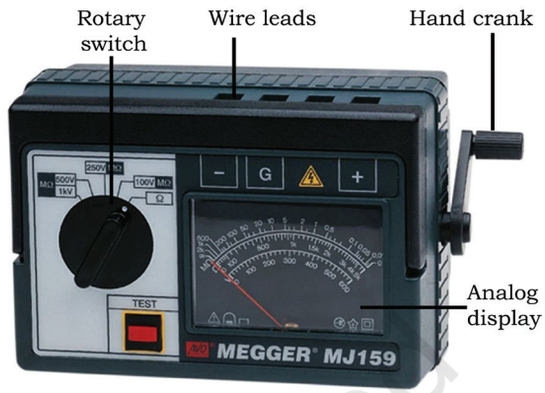

Fig. 7.26 Manual megger meter

Hand crank

It is used to generate voltage, which runs through electrical systems through desired RPM (rotation per minute).

Wire leads

These are used for connecting the tester with the electrical system as in an electronic megger meter.

Fig. 7.27 Wire lugs

Wire lugs

These are connecting terminals used to connect the conductor wire to a circuit. Wire lugs are a class of electrical connector, which are used to transfer electrical current from a power or grounding source to a user. After which terminals are terminated by using crimping or soldering technique.

Wire stripper

A wire stripper is often considered an important tool for electricians and other related personnel.

It is a portable handheld tool, especially, used by electricians for removing the protective coating of

Fig. 7.28 Wire stripper

an electric wire in order to replace or repair it. It also enables stripping the end portions of the wire in order to connect them to other wires or terminals.

Wire strippers can be categorised into two types — manual and automatic. A manual wire stripper is considered the most versatile. To use it, the user needs to manually rotate it while applying pressure around the insulation in order to cut or adjust the wires. In case of an automatic wire stripper, one side is held tight, and simultaneously, the other side is cut and removed. An automatic wire stripper can help even a novice cut and strip most wires quickly. However, it only works for certain size range of wires. It can break small wires. Large wires may not fit into its jaws.

Wire strippers are available in various shapes and sizes and are, usually, made of steel. They, usually, have serrated teeth, which are useful in stripping the wires. The handles can be either straight or curved, and in most cases, are covered with rubber coating to provide a secure grip. Wire strippers often have a wire cutter as well.

Wrench

Also called 'spanner', it is used for rotating soft iron pipes and fittings with a rounded surface. The design of the wrench's adjustable jaws allows it to lock in the frame, such that any forward pressure on the handle tends to pull the jaws tighter together. Teeth angled in the direction of turn dig into the soft pipe. They are not intended for use on hardened steel hex nuts or other fittings because they may damage the head of the hex nuts. However, if a hex nut is soft enough that it becomes rounded beyond use with standard wrenches, a pipe wrench is sometimes used to break the bolt or nut free. Pipe wrenches are classified by the length of the handle. They can be available in any size from as small as 3 inches up to 48 inches or even bigger. They are, usually, made of cast steel. Aluminium is also used to construct the body of the wrench, while the teeth and jaw are of steel. Teeth

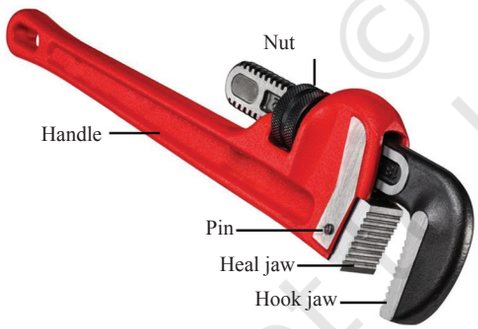

Fig. 7.29 Pipe wrench

and jaw kits, which also contain adjustment rings and springs can be bought to repair broken wrenches as it is cheaper than buying a new wrench.

Hammer

It is a tool, consisting of a metal piece with a flat end that is fixed onto the end of a long, thin, usually, wooden handle used for hitting things, shaping metal sheets, etc.

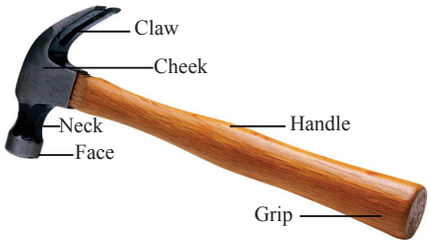

Fig. 7.30 Hammer

Ladder

A ladder is a vertical or inclined set of steps. There are two types of ladder. Rigid ladders are self-supporting or may be leaned against a vertical surface, such as a wall, whereas, rollable ladders like those made of rope or aluminium that may be hung from the top. The vertical members of a rigid ladder are called 'stringers' or 'rails'. Rigid ladders are, usually, portable, but some types are permanently fixed on to a structure, building or equipment. They are commonly made of metal, wood, fiberglass or plastic.

Fig. 7.31 Ladder

Check Your Progress

A. Multiple choice questions

1. Which of the following quantities can be measured using a multimeter?
   (a) Voltage
   (b) Current
   (c) Resistance
   (d) All of the above
2. Which of the following tools is used for shaping a metal into a sheet?
   (e) Hammer
   (a) Screwdriver
   (b) Stripper
   (c) Wrench

3. Pipe wrenches are available in sizes from _____ to _____ inches.
   (a) 1, 50
   (b) 3, 48
   (c) 4, 58
   (d) 1, 45
4. Wire stripper is categorised as _____ and _____
   (a) vertical, horizontal
   (b) straight, aligned
   (c) manual, automatic
   (d) fix, movable
5. Which of the following is used as a wire connector?
   (a) Lug
   (b) Screwdriver
   (c) Stripper
   (d) Hammer
6. Which of the following meter is used for insulation resistance testing?
   (a) Ammeter
   (b) Voltmeter
   (c) Wattmeter
   (d) Megger meter
7. Which of the following equipment is used to measure AC voltage?
   (a) Tachometer
   (b) Multimeter
   (c) Ammeter
   (d) Megger meter
8. Which of the following meters is used to measure insulation resistance?
   (a) Tachometer
   (b) Multimeter
   (c) Ammeter
   (d) Megger meter
9. Which of the following tools is used for turning soft iron pipes and fittings with a rounded surface?
   (a) Wrench
   (b) Plier
   (c) Wire stripper
   (d) Screwdriver
10. Which of the following tools is used for the removing the insulation of a wire?
    (a) Plier
    (b) Wrench
    (c) Wire stripper
    (d) Hammer

B. Fill in the blanks

1. Combination plier is used for _____ and _____.
2. Pipe wrenches are available in size from _____ to _____ inches.
3. The process of melting a metal onto other metal components in order to bind them together is called _____.
4. Megger meter is classified as _____ and _____.
5. Soldering is also known as _____.
6. Ladder is classified as _____ and _____.
7. In line tester, _____ bulb is used for the indication of live wire.
8. In drilling practice, _____ is used for making a hole in the wall or wood.
9. A multimeter is used for the measuring of resistance, voltage and _____.

C. State whether the following statements are True or False

1. Soldering is known as metal glue.
2. A clamp meter is used to measure current flowing inside an electric wire.
3. A multimeter is used for the testing of diode.
4. A combination plier is used for stripping insulation in a wire.
5. A line tester is used for testing diode.
6. A multimeter can measure AC and DC voltage.
7. Lugs are used as wire connectors.

D. Short answer questions

1. Write short notes on the following.
   (a) Screwdriver
   (b) Megger meter
   (c) Multimeter
   (d) Combination plier
   (e) Line tester